

# Preliminary Findings of the NASA Scenario Interviews

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(Document to be augmented by further analysis before public release.)

## *Preliminary*

### **Question 1:**

***It is 1980. What is the aeronautics industry like? What is the mission of NASA Aeronautics?***

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#### **Summary:**

The consensus was that 1980 was the end of an era. The aeronautics industry was robust and healthy. Both the military and civilian markets were developing new aircraft. The jumbo jet was being introduced into the civil side and stealth was the name of the game in the military side. New propulsion systems were being developed to support both military and civilian airframes. Inflation was relatively high and taxes were relatively low. General aviation had reached its peak. Airline deregulation was starting to be felt in the industry and many air carriers would not survive without subsidies. General aviation was confronted with a disturbing number of lawsuits. Military was still fighting the cold war and enhanced weapons systems were being purchased.

NASA's mission was essentially the same as today, but, the interpretation of that mission was varied. The main thrust of NASA in 1980 was space. Aeronautics was a "poor" second. The aeronautics work that NASA supported at this juncture was highly military oriented and supported high speed research. Basic research continued in NASA core technologies of propulsions, aerodynamics and materials that also supported civilian technology.

#### **AERONAUTICS in 1980**

"Looks like a period of reasonable health"

"Balance between military and civilian in the industry"

"General Aviation and product liability was a major issue."

#### **DEREGULATION**

"Airline deregulation had started, airlines were starting how to control their industry by scheduling, managing cost and route structures."

"Certainly the most defining element of the early 1980s was deregulation. It created a new transportation system and a new air traffic control system (ATC).

"The thinking was dominated by performance of vehicle rather than life cycle costs."

#### **ECONOMY**

"Low taxes in US with plenty of consumer confidence. The Japan bubble economy is just heating up. US interest rates are being kept artificially high which raises the cost of capital in the US. The unanticipated consequence is that the Europeans get a window of opportunity to develop their aircraft industries. Manufacturing and distribution are becoming global as the electronics industries are exploding on the scene."

"In 1980, airline deregulation had a major impact. There was financial uncertainty. The airline business went from years of profitability to uncertainty and losses after deregulation. There were five years of losses following deregulation. Deregulation changed the way the airlines did business. There was a major shake-out. The market for commuter aircraft increased. This permitted Brazil and others to have a market in the U.S."

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### **DEPARTMENT OF DEFENSE**

“In a nutshell, it was a relatively healthy Cold War period. “

“There was lots of complacency and expectation that the current situation would continue.”

“1980s - Technology driven era both civil and military. Cost was not a problem  
Super critical wing - first for speed then for more fuel holding.”

“DOD was the big market. Stealth technology was the inroad.”

### **NASA MISSION**

“There was a lot of space work being done by NASA. They (NASA) were being driven by the Cold War and enjoyed strong national support. They were excelling in the space business.

“(NASA) Did not have as many focus programs as today, performed more basic research, and there was no pressure to pursue technologies that had direct effect on creating jobs.”

“NASA’s mission during this period was essentially to (1) pursue basic research; (2) work closely with DOD and industry in addressing problems of current systems; (3) national missions such as helping to create more fuel efficient aircraft; and (4) validate new technologies.”

“By 1980 in military aeronautics we were pushing the frontiers of what you could do with an aircraft. NASA missions during this time reflected this. In commercial aeronautics, industry was quite complacent. Even though Airbus was becoming a major competitor, there was a strong view in the aeronautics business that we were better. Mostly, the NASA missions were in support of the military. Our budgets for military research were four times what they are today. The commercial sector in 1980 was much more independent of NASA. Industry made few requests of NASA.”

“NASA mission has been pretty well defined: To provide the under lying technologies for industry to produce good aircraft, example: boundary layer research. This mission has not changed over the years.”

“NASA space is strong but aeronautics is weak. Mission is not focused.”

“NASA research generated systems that benefited longer-term issues and were less focused.”

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### **Question 2:**

***How would you compare that to the aeronautics industry of 1996? In your own words, what is the NASA Aeronautics mission in 1996? What would you list as the critical technologies? Why?***

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### **Summary:**

The aeronautics industry today is being driven by the civilian demand for air travel. Business parameters are no longer faster, higher, lower drag with technology being pushed onto new airframes by manufactures. They have become lower design and manufacturing cost, reduced risk, with new technologies having to buy their way onto airframes with airline pull. There is now a strong competitor in the civilian transport market with the introduction of the European Airbus consortium and the survival of one of the two main airframe manufacturers in the US is in question. The air traffic control infrastructure has become a major constraint on the airlines flexibility and profitability.

With the end of the Cold War in the 80's there has been a major reduction in military hardware purchases and the number of aerospace contractors. This downsizing has left two major military fixed wing airframe manufactures active in today's market. There is still a number of rotary wing manufacturers, but they have also felt the reduction in military spending and it appears there will be some future consolidation in this field. The Department of Defense is no longer able to do new research in technologies that can be easily crossed over into the civilian market place. Their concentration in recent years has been in the areas of stealth, fire control systems, smart weapons, not more efficient engine design and better cruise efficiency.

#### **DOWN SIZED INDUSTRY**

"The military market has almost completely dried up."

"General Aviation today does not look much better then it did in the 80's when liability almost destroyed the market."

"There are only two military contractors left, McDonnell Douglas and Lockheed-Martin, and these manufactures lack creativity and are driven by profit."

#### **SHORT RETURN CYCLE**

"Industry is more short sighted, they concentrated on derivatives (737-xxx) rather than leap ahead with new aircraft designs."

"The airframe manufactures are trying to make money, not develop technology."

"Vehicle concepts such as the HSCT or short haul/tilt rotor will not be built by industry until they can make a profit on their production."

#### **LOW MILITARY DEMAND FOR NEW PRODUCTS**

"The industry is no longer driven by fears of the cold war, what we have is a list of annoying states and a lot more economic competition (Airbus)."

"In 1994 and 1995 Switzerland bought more fighters then the US military."

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### **NEED FOR A NEW AIR TRAFFIC MANAGEMENT SYSTEM**

“American Airlines did a study called ‘User Controlled Routes’. They claim that such a discretionary system could save the airline industry \$1.5 billion in the 2005 when compared to traditional air traffic control systems.”

“Air fleet management is an issue, we should be able to track and control all the air traffic in the world.”

“The advanced traffic management concept is a 1996 effort. Today, system-wide control is a possibility.”

### **LOSS OF U.S. DOMINANCE**

“Our industries are not as dynamic as foreign industries. This is because our industry is not as forward looking as those in other cultures.”

“Rolls Royce is strong with new technology programs sponsored by the European governments.”

“If the US pursues the High Speed Civil Transport (HSCT), the US can recapture its market dominance.”

“By 1996, Airbus had one-third of the air transport market.”

## **Question 2, Part II:**

***In your own words, what is the NASA Aeronautics mission in 1996?***

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### **Summary:**

There is much uncertainty about what is or should be NASA’s mission in 1996. NASA is in a period of time where the focused program with a completion point of no longer than 7 years is the driver for research. Not many agree with this strategy and think that a diverse portfolio of research projects with differing completion dates and risk levels is the right avenue to pursue. The areas of research that have received the most support were those that were high risk with a high potential for payoff for the aeronautics industry. These are the types of research programs that industry can not afford to due on their own. NASA Aeronautics must show that the research they conduct improves American’s standard of living through better paying jobs or an improved transportation system.

There was much discussion about the place of NASA Aeronautics in the future. The combining of resources from many different agencies to improve research potential and reduce overhead was often mentioned. Also, a loss of expertise by NASA due to the fact that they have been unable in recent years to recruit and maintain high quality young engineers was of much concern.

### **UNCERTAIN ABOUT SCOPE OF RESEARCH**

“NASA is not certain what its mission is, they are currently doing focused programs, but some in NASA want to return to doing more basic research.”

“NASA needs to develop both short and long term technologies that will supply high payoffs to industry.”

“The focused programs that NASA is currently working on are the right types of

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technologies to pursue.”

“The cause of the shift to short term research is that when money is tight, long term research is the first to get cut.”

“Access to space is a ‘low ball’ to the aeronautic industry because when the space budget came under constraints they created this air breathing access to space program. They are taking money from aeronautics to pay for space access.”

“We should have differing groups of projects that have high potential pay off in five, ten, and twenty five years. Right now all the focus programs are designed for seven years and then they are completed. This is too soon for many technologies.”

“NASA has a clear role in technology development, not product development.”

### **REWARDS FROM RESEARCH**

“A challenge to NASA is to sell the US public on the benefits of Advanced Subsonic Transport research to the basic traveler.”

“NASA invested \$200-250 million in the EQ engine, which was then followed by a \$2 billion investment by GE. Products from this research created \$10 billion in sales over the next 20 years, led to 5,000 direct jobs, 10,00 indirect jobs and \$900 million in tax revenues. The result is, NASA’s investment is good for the economy.”

### **NEED TO TEAM WITH OTHER AGENCIES**

“CTAS is a good example where NASA R&D benefited the FAA (but, the FAA is reluctant to use it).”

“Spin off of Aeronautics and possibly combine with the FAA.”

“I am not convinced aeronautic should be in NASA. I think we should take all the R&D out of NASA and combine it with funds from the FAA and DOD aeronautic research creating a new agency called the National Aeronautics Agency.”

“The air traffic management partnership between FAA and NASA is a good one. The FAA has not proved itself at doing research while NASA has.”

### **WORK FORCE**

“NASA Aeronautics has been unresponsive to this trend of not attracting quality people, it hasn’t reformed itself because the civil service is its silent killer.”

“The dilemma is that young quality people are only attracted to NASA if it is working on sexy technologies. Aeronautics is a mature industry, something is needed to excite young people to get into aeronautics, they need an ER or LA Law for aeronautical engineers.”

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### **Question 2, Part III:**

***What would you list as the critical technologies? Why?***

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#### **Summary:**

The critical technologies cited fall into one of four categories. There are capacity issues, process technologies, infrastructure, and breakthrough advances in current technologies. Capacity issues range from information technologies and their effect on air traffic management to environmental issues that could reduce air transport. Process technologies are those technologies that could shorten design time and lower the unit cost of each aircraft. Infrastructure relates to the wind tunnel facilities and research laboratories in the country. Finally, breakthroughs in engine or air frame materials are considered key if US aeronautics is going to remain a leader in the world market. These four areas encompass the list of critical technologies.

#### **CAPACITY ISSUES**

“Cities are not going to build more and more airports, so if capacity is going to increase the system has to be improved; satellite navigation and computer based scheduling will save money for the airlines.”

“Information technologies, not technology development but innovative applications of information sciences, will be critical.”

#### **PROCESS TECHNOLOGIES**

“Industry worries more now about processing technologies so that designs are done correctly the first time.”

“NASA should focus on the computational field because it can be used as a design tool.”

“Better models are needed to predict the success of an airframe earlier to reduce manufacture’s risk.”

#### **INFRASTRUCTURE**

“NASA facilities are a critical technology to US industry.”

#### **BREAK- THROUGH TECHNOLOGIES**

“Advance materials is an enabling technology. There is a rapid and exciting change in this field. We can create and design materials on a computer. We can then model these materials. Industry has no such capabilities, moreover, we can cooperate with other disciplines.”

“Propulsion is on the verge of a big advancement, with NASA supporting engine development for General Aviation with the General Aviation Propulsion (GAP) program.”

“Propulsion advances have in the past driven breakthroughs for aeronautics, GAP will hopefully prove to deliver a breakthrough for the general aviation market place.”

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### **Question 3:**

***Who are the key players in the global aeronautics industry today? How do the key players interact? What role do governments play? Are they all subject to the same pressures for change? Who is at risk? Why?***

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#### **Summary:**

There was a general consensus that currently Boeing is “the” key player. Boeing does, however, face stiff competition from McDonnell-Douglas and globally from the Airbus consortia and in the future from current and emerging world multinational and nationally supported aeronautics industries. The major aeronautics suppliers are also key players, especially engine manufacturers, include Pratt & Whitney, General Electric, Rolls Royce. Other global players include the airlines United, American, Delta, Southwest, British Airways, Air France, Japan, Singapore, and Lufthansa; all of whom have a great influence on aeronautics. On the military side the US players include Lockheed-Martin, McDonnell-Douglas, Northrop, Sikorsky, Bell. Government organizations such as NASA, FAA and DOD were also mentioned

There was not a consensus on how these players interacted or on the role that government played in these interactions. It was felt that in the US that this was a fickle environment that was as changeable as the politics of the day. It was noted that the US companies are now starting to cooperate more because the competition they face is from multinational government sponsored consortia. The US antitrust laws continue to put the US at odds with the rest of the world.

There was some consensus on risk in the aeronautics industry but only from the view that everyone seems to be at risk in one way or another.

#### **MANUFACTURES**

“Boeing, Airbus, Pratt & Whitney, GE, Rolls Royce, McDonnell Douglas (commercial?, military+), Lockheed Martin (military)”

“Airbus is a match for Boeing. Boeing has exploited economics of scale and some technological advantages to keep up with Airbus. In 1994, Airbus matched Boeing in orders.”

#### **AIRLINES**

“United, American, Delta, Southwest, Air France, British Airways, Japan”

#### **AGENCIES/ GOVERNMENTS**

“NASA, DOD, FAA (?), NTSB, Congress/White House, Japan”

#### **POWER IN COMPANIES, NOT GOVERNMENT**

“Military: McDonnell Douglas, Lockheed Martin, Northrop (they might survive)  
Commercial: Boeing, McDonnell Douglas (?), Airbus

Airbus: They have some problems, they have been financed by European governments so far but this funding will end some time and they will have to compete on their own merits. This real environment will hurt Airbus’s competitiveness.

Infrastructure: American universities and the support they receive, and give, to NASA.

NASA: Lost right now in the market place, they dominate: wind tunnels and exploring new technologies.

Airlines: They are setting the requirements for the market place, industry must



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be responsive to the airlines.

FAA: They must be brought into the fold to allow the process to be sped up.

European Industry: A thin line between government and industry.”

“NASA is not a major player. In the 1980s, a proposal was offered to close the Lewis research center. Industry took no action in order to oppose the proposal. Industry benefits from NASA. However, it does not consider NASA as a crucial member of the aeronautics industry. This is the case in spite of the fact that industry is currently conducting very little research. Pratt & Whitney, Boeing, and Lockheed-Martin all closed their research centers. GE continues research, however it is one of the few retaining its research capabilities.”

### **DIVERSE INDUSTRY**

“There is a diverse group of players in the aeronautics industry. DOD and NASA are major players. The Europeans are getting closer to having a federal agency of their own equivalent to NASA. It would give such an organization the resources to be a major player. The primary industrial players include manufacturers such as Boeing, Airbus, Pratt & Whitney, Rolls Royce, and GE. Lockheed and McDonnell Douglas are major players on the military side. Aerospatiale is a major player. If the Russians ever get their act together they have potential to be major players.”

**Question 4:**

***Now thinking about the future, what do you think the global aeronautics industry will look like in 25 years; how will it operate? What are the principal trends under way that will stimulate the changes you envision?***

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**Summary:**

The global aeronautic market looks strong for the next 25 years. There will be substantial growth in the number of people flying and the route structures in South East Asia. This growth could spawn a whole new generation of large jumbo or supersonic aircraft. Advances in satellite navigation and communication data link will also help the industry reach new heights. However, this growth does have some limiting factors. The aging infrastructure in mature markets and the cost of building new infrastructure in emerging markets could create an air traffic wall. There is also concerns about the growth of terrorism and business travelers staying at home and using teleconferencing as a way of doing business.

The United States position in this market place is a very tenuous one. Competition to US dominance in the future will not only come from the European Airbus consortium, but from possibly Russia, Japan, China, or South America. There is strong push by many governments to develop a local aeronautics industry to supply high paying jobs and international prestige. International consortium will be more prevalent in the future to reduce the amount of risk taken by any one company. These consortiums could lead to the relocation of many manufacturing jobs off of U.S. soil.

<b>MARKET DRIVERS</b>
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“In the US 75-80% of the population have been in an airplane, right now only 2% of the Chinese have had this experience. In the future their numbers will begin to approach those of America, this is a area of tremendous growth potential.”

“There will be better air traffic control that will increase the capacity for aircraft, especially trans. ocean routes.”

“The demand for air travel from leisure travelers combined with air traffic congestion will require more research in creating large aircraft. Perhaps planes with 1,000 person capacity will be required.”

“Conventional wisdom says computers and Information Technologies (IT) will reduce the need for air travel, especially for business travel. But, it could go the other way. IT advances may propel business travel because executives will have the capability to communicate with the office while on the road.”

“A growth in the small aircraft industry from 0.01% of the population flying to 10% of the population is possible.”

“Demand will shape the future. Military requirements are changing rapidly. Battlefields will be dominated by skirmishes where quick response is essential.”

“If the US can not build more airports the aircraft will become much larger, 1,000-1,500 passengers.”

“Communication industry will have a huge impact on what flies and why. Business flight will diminish; pleasure flights will increase. Airline business will

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become more of a commodity. Cargo air freight will be the major mover of high cost materials. Emphasis will be on just-in-time manufacturing. Manufacturers will have STOL airports next to facilities. Cargo aircraft will be large highly maneuverable aircraft accessible to short runways. General Aviation aircraft will be as easy to fly as a car and cost about the same. The emphasis will be on more smaller personal aircraft. Military aircraft emphasis will be on advanced weaponry. Military and civil air freight will essentially have the same airframes. There will be joint military and civil air freight partnership in developing technology.”

“The traveling public will be more recreational; business travel will stabilize at a modest level; home based web-oriented information technology will be the norm. The civilian recreation traveler is interested in safety and economy. The business traveler is interested in efficiency without delays.”

“Subsonic airborne buses - new ways to move people to airports.”

“A whole new era, GA aircraft are an order of magnitude easier to fly, cheaper, less regulation. There will be 1 million pilots versus 600 thousand today, an active fleet of 220-210 thousand GA aircraft versus 160 thousand today.”

“China will enter as a major market, incorporation of Hong Kong will help. Vietnam and Malaysia will also be growing markets for new aircraft sales and flight routes.”

### **LIMITS TO GROWTH**

“We are about to hit a wall as far as being able to handle more of a load on infrastructure. There will be more problems with natural resources and pollution in the form of emissions and noise.”

“The military threat to the US will be in the form of terrorism.”

“Looking out twenty-five years, a development that I think will have a profound impact on the aeronautics industry is the tremendous growth in leisure travel.” This will create a major traffic control problem. Not far into the future we are going to run into an air traffic wall. We will have a traffic jam of incredible proportions.”

“The Internet will undermine domestic business travel.”

### **NEW TECHNOLOGIES**

“The one big surprise in the future will be in materials. If we have a breakthrough in materials like the electronics breakthrough, it will completely revolutionize our travel.”

“A supersonic transport will fly the Pacific because the market will demand it.”

“In twenty-five years we will be starting a new generation of aircraft to leap frog SST technology, this will be closer to a space plane.”

“There will be fewer air carriers, transport aircraft will be able to fly half way around the world at near supersonic speeds.”

“Helicopters will be quieter, have a lower empty weight fraction because of the introduction of composites, they will be used in hub and spoke short haul operations into airports. Tilt rotor will be used for airport to airport short hauls.”

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<b>COMPETITORS IN MARKET PLACE</b>
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“More unmanned vehicles.”

“GPS will have a major impact on new systems (Free Flight).”

“There will be the entry of possibly two more major competitors in the market place, Russia and one of the following: Japan, India, Indonesia, or South America.”

“Europe is interested in air breathing access to space and are currently investing in facilities to simulate the propulsion and heating necessary to operate at high mach numbers. The French have been exploiting the Russian facilities, this is a major threat to US industry world leadership.”

“Japan is already investing 1/2 billion dollars in hypersonic programs.”

“There will be more international collaborative and combined efforts. HSCT is an example where, due to the high cost, a consortium may enter the development competition and change the game.”

“International partnerships, perhaps with the Russians. The Japanese are currently buying Russian expertise, not Russian Companies.”

“The supersonic transport will be built by an international consortia.”

“Boeing, Airbus, and some sort of Japanese Airbus will be the three dominant players.”

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### **Question 5:**

***What kinds of key events or situations could arise in the time frame (25 years) that you would consider plausible, yet could cause a major derailment or deflection in the evolution of the industry you described above?***

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### **Summary:**

The consensus considered war, terrorism, and environmental conditions may cause a major derailment or deflection in the evolution of the aviation industry. A major war could effect the level of world airline travel and governmental expenditures on improved civilian infrastructure. Any military unrest or political instability in the Middle East would affect the access to an important portion of the worlds oil supplies. This could possibly create a fuel crisis similar to that in the early 70's. Without the development of fuel alternatives this crisis would have a detrimental effect on the airline industry. The airline industry has been able to absorb many small increases in fuel cost but would be almost impossible to react to a sudden rise in prices. Environmental issues involving fuels, noise, and ozone may hamper the future development of the supersonic aircraft market. Airport development and expansions to accommodate the predicted volumes could also be effected.

Although war would be a preventable event, terrorism creates a great unpredictable risk in the aeronautical industry. For example, what the PanAm 747 went down in Lockerbie, Scotland, there was a 50% drop in Trans.-Atlantic bookings. If the same drop would occur in reaction to a domestic incident, the effect could be very detrimental to the airline industry. Terrorism has increased the demand for newer bomb and weapon detection devices used in airports around the world, and which has forced the government to provide more funding for airport security.

#### **AVAILABILITY/ COST OF ENERGY**

"....with an oil embargo, aircraft would have a hard time switching to alternative fuels if oil was to run out.

" In a positive sense, the direction of industry could be directed by a completely unpredicated event such as a new engine design or a new type of fuel. On the negative side, a major derailment could occur if we could not get adequate amounts of fuel or if fuel prices tripled."

#### **ECONOMICS**

"The buy American concept; having countries close off their markets to outside competition. This would also close off teaming with foreign partners, which would close down on new foreign technologies finding their way onto U.S. aircraft."

"Currently the cost of the airplane is the dominant cost, not fuel. 777 cost \$5B and it takes 7 years to recover that cost."

"China Growth- U.S. depending on growth of sales with China. If this doesn't happen it would have serious impacts."

"The viability of a hypersonic/supersonic jet depends on economic feasibility."

"Global economy is closed down by increasing tariffs."

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### **SAFETY**

“.....Also, the accident rate of the industry will play a role in defining the future. Directly tied to the safety factor is whether or not we can effectively handle larger and increased volume of aircraft.”

“Terrorism will affect some leisure travel, but business travel will continue in spite of terrorist acts against airlines.”

“Congressional passage of new safety legislation that pleases the population ,but has no real effect on improving safety, increases, significantly, the cost of operations that could ruin the industry.”

“..safety issues relating to aging aircraft fleets will arise.”

### **THE ENVIRONMENT**

“Environmental restrictions could also impact the industry , but, there are practical limitations to how low one (aircraft altitude) can go. Noise control, restricted altitude, restricted airspace are other less potent forces.”

“discovery of a very bad public health threat: flying above 40K ft is ruining ozone, etc..”

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### **Question 6:**

***In the context of your vision of the future, what do you see as the strengths and weaknesses of the US aeronautics industry?***

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#### **Summary:**

The consensus was that the US is dominant in the aeronautics field and rightfully so. Aeronautics accounts for the major portion of the asset side of the balance of payments. Capitalism, democracy and the American spirit are our strengths. A number of other strengths were also addressed e.g.: pride, tradition, ingenuity, system integration, corporate knowledge, global supplier network, and the American worker. Generally there was a great deal of optimism about the future of US aeronautics.

There was, never the less, a list of weaknesses that need to be taken into consideration. These included everything from anti trust laws to “downright laziness”. The weaknesses addressed also included: bureaucracy, short term goals, weakening education system, lack of funding, high production costs, cynicism, shortage of aeronautics workers ,etc.

#### **STRENGTHS**

“Capitalism, our companies have always worked under the idea of be strong or die.”

“The ability to harness information, understanding of the whole manufacturing process, ability to manufacture cheaply, influx of computer technologies.”

“We can rally towards a common goal, we can pull together.”

“Yankee ingenuity, competitiveness, integrated design tools could really put us in the lead.”

“The ability to collaborate in more strategic partnerships.”

“The U.S. has a great tradition, pride, corporate knowledge, industry and social economic support and a will as a nation to support R&D. Our industries are efficient enough to develop new products and new ideas.”

“Strengths of the U.S. are the will to succeed and the U.S. people.”

#### **WEAKNESS**

“Our educational system is losing our technical capacity for the future.”

“The aeronautics industry is too near-focused.”

“The Roman Empire factor, too rich, too fat, could kill us; we are better catching up, not leading.”

“Political System”

“Our loss of the will to succeed”

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### Question 7:

*Imagine an operating environment (25 years from now) that you would consider the worst nightmare for the US aeronautics industry. What are the characteristics of that world?*

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#### Summary:

In general the “worst nightmare” answers fell into four distinct categories: 1.) fuel shortage, 2.) war, 3.) flying becomes unsafe, and 4.) foreign technology breakthrough. There was also some mention of the US losing their competitive advantage and the possibility of alternative transportation.

#### **FUEL SHORTAGE**

“Completely run out of oil because there is not research now or plan for the future on alternative fuels.”

“Cost of Energy (fuels) increasing dramatically.”

“What if our estimates of our fuel reserves is wrong?”

“No more fossil fuel, this would eliminate aviation as we know it.”

#### **WAR**

“A Bosnia-type world with sectors and blocs.”

“Prolonged regional conflict.”

“Isolationism because of fear or world unrest.”

“Regional/multi-regional war.”

#### **FLYING BECOMES UNSAFE**

“My greatest nightmare is a lot of accidents in a short period of time.”

“TERRORISM - freewheeling and uncontrolled attacks.”

“Safety - accidents - could derail aviation-system”

#### **FOREIGN TECHNOLOGY BREAK- THROUGH**

“My worst nightmare is that a competitor (another country) builds a new system and we do not. A candidate might be an engine that uses only 50% of the current fuel of our engines.”

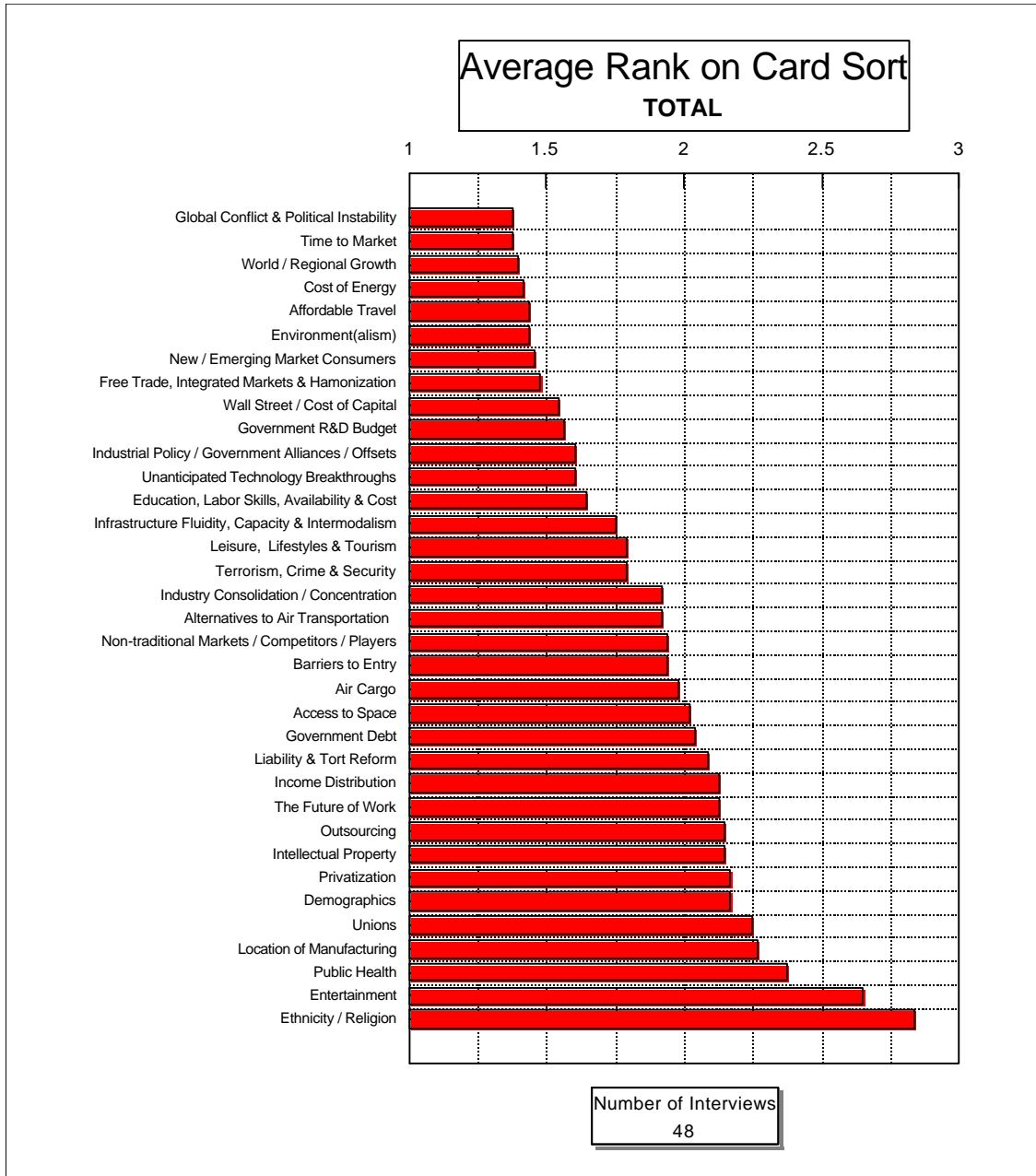
“Some invention that would replace the need or desire to ‘be there’.”

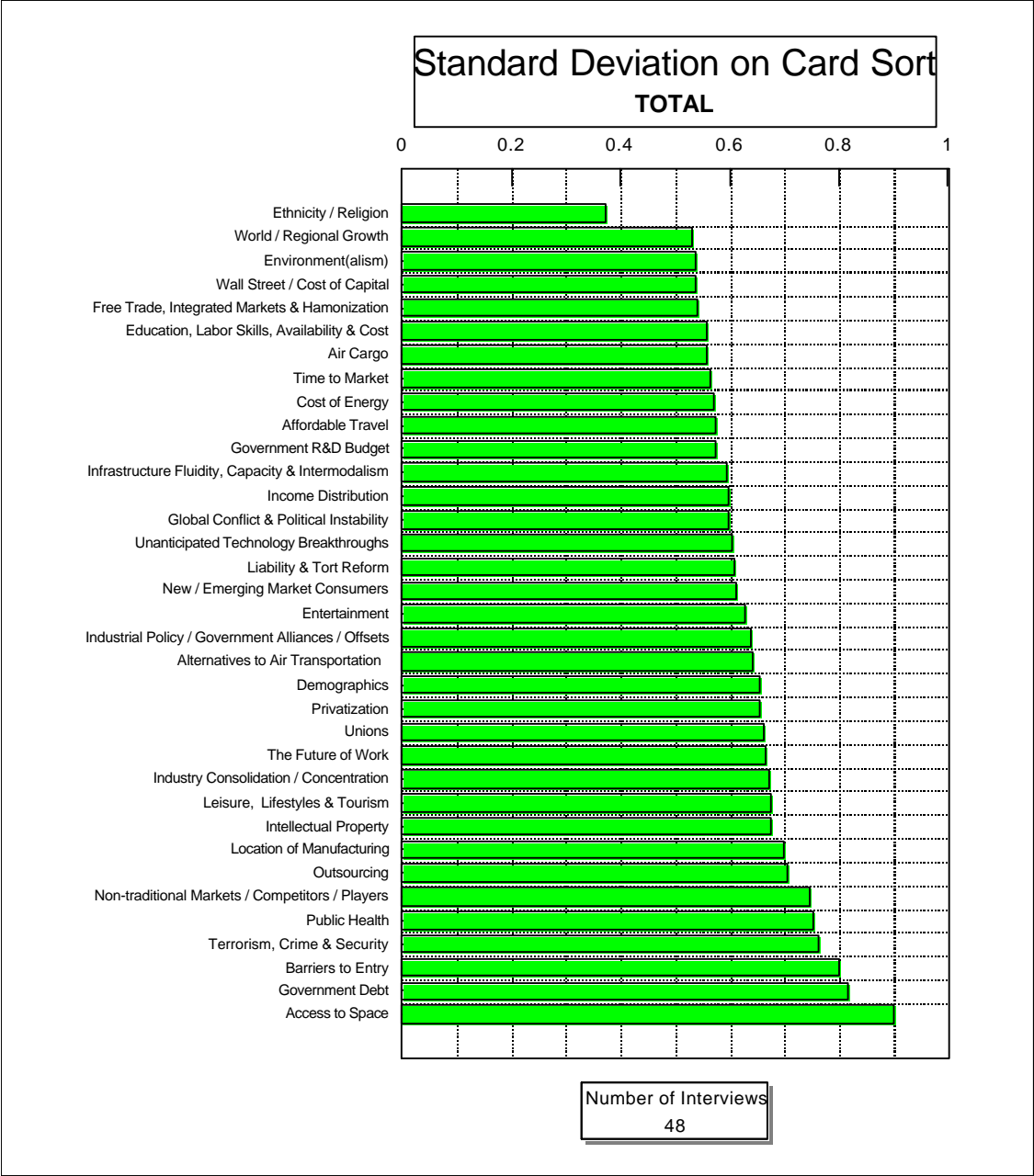


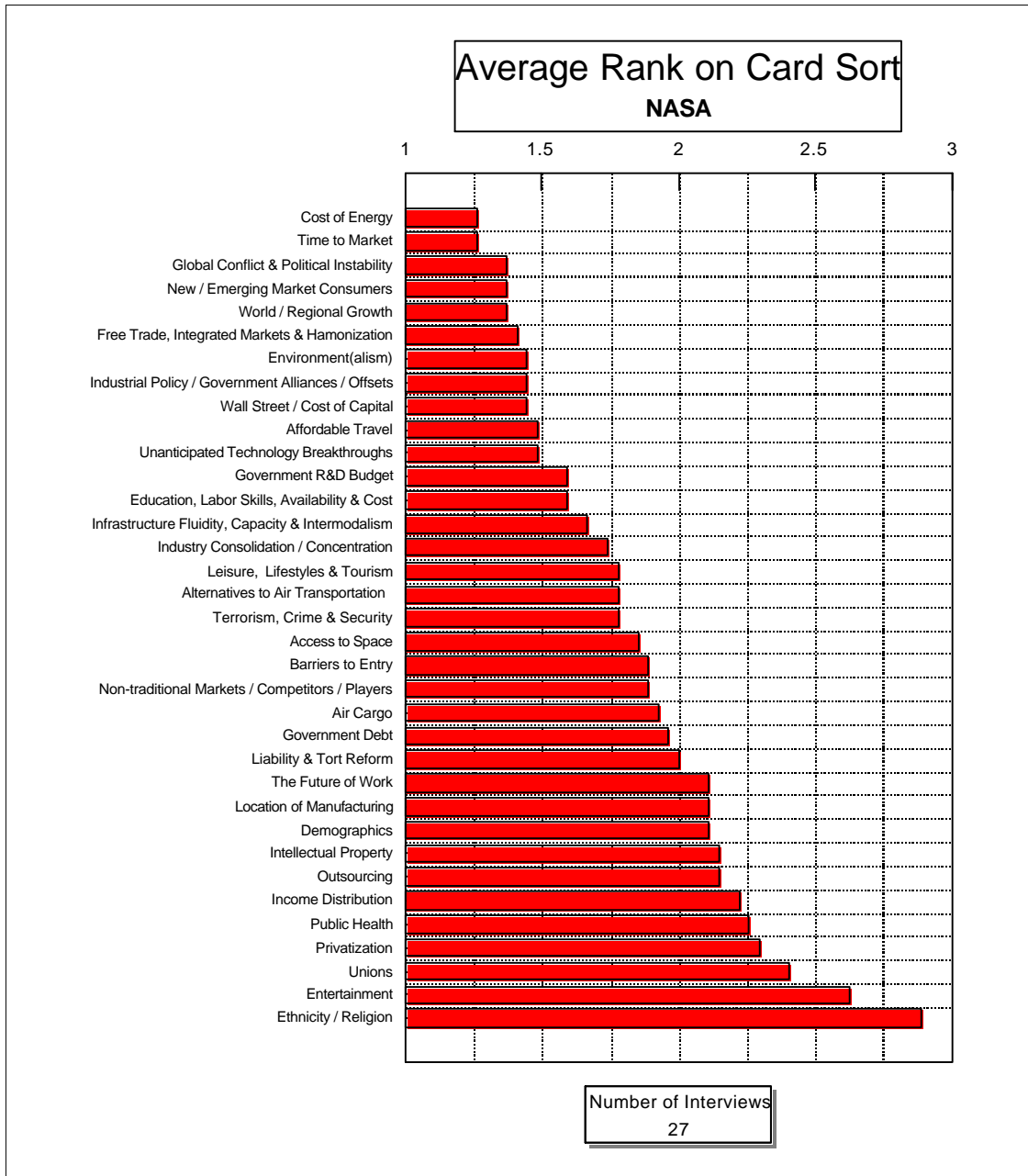
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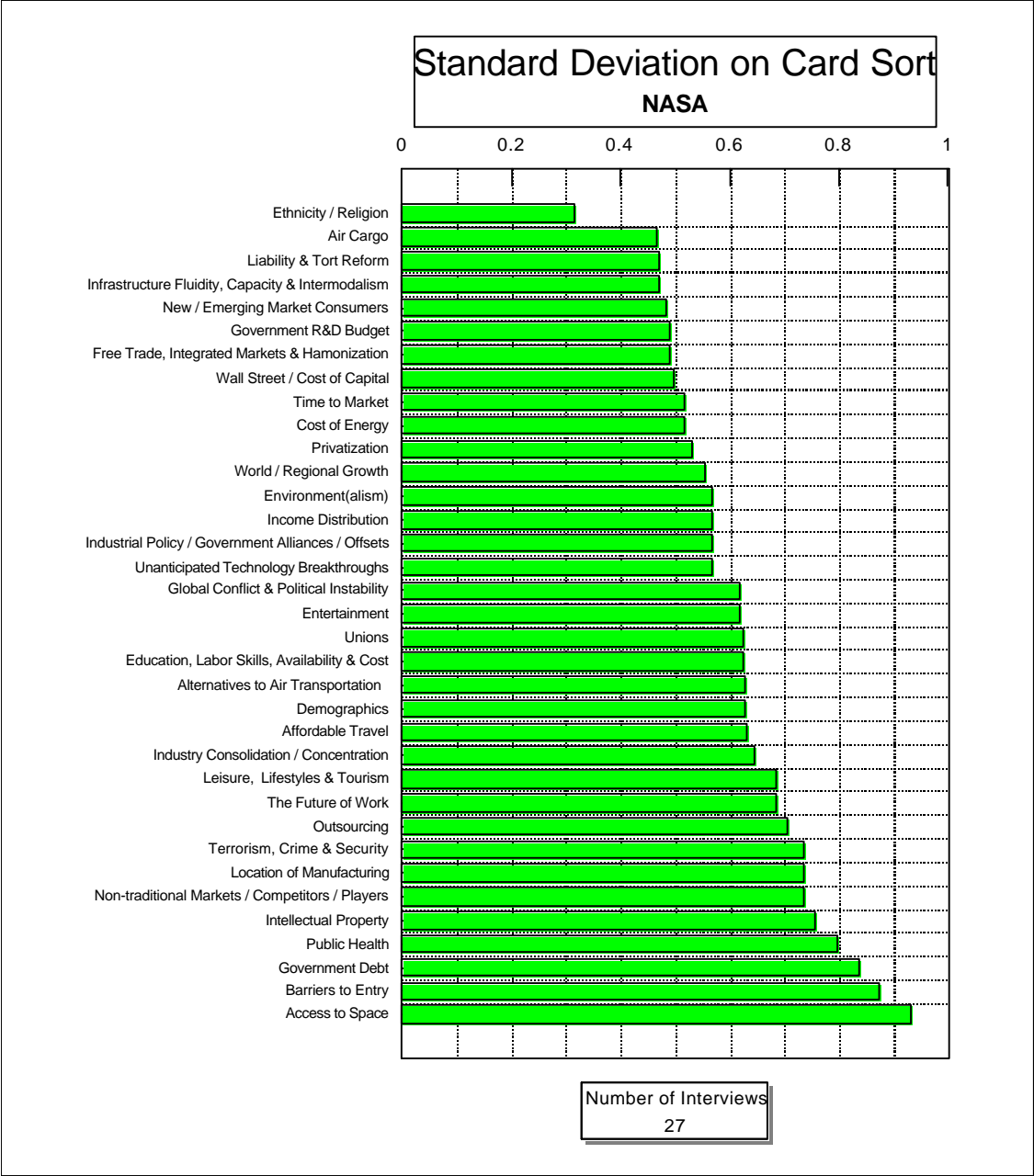
**Question 8:**

*Now we would like you to think about the range of global external forces that may shape the future of the demand for high speed transportation and delivery services.*









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### **Question 9:**

***What should NASA Aeronautics be willing to give up?***

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#### **Summary:**

From the interviews conducted there was emphasis placed in two areas on what NASA should dis-invest itself from. These areas were research that industry could or should conduct on their own and research that industry would not be able to reap any benefit from when completed. Short term focused programs were often mentioned as areas that industry could do on their own. Low risk developmental programs for subsonic and general aviation were often targets for cut backs. It was questioned if industry was really ready to exploit the results of the High Speed Civil Transport (HSCT) program.

There were those who also stated that NASA Aeronautics had been cut back far enough and should start to draw back from programs that benefited other agencies rather than aeronautics as a whole. Programs such as High Angle of Attack research for the military and Air Traffic Management for the FAA were high on the list of areas for NASA to remove itself from.

#### **AREAS**

“Neat technologies that do not have a large payoff on the system as described by the end user (airlines).”

“Near term research activities need to be dis-invested in. There needs to be a balance between near, middle, and long term research goals. Research projects need to be prioritized with the benefit of the research directed at the tax payer rather than the industry solely. There is an over investment in GA.”

“NASA should be out of super computing, or any kind of computer design or development, industry has this well in hand.”

“Propulsion, the current research is closely aligned with what industry is doing and they could probably do a better job themselves.”

“NASA should get out of the subsonic and general aviation portions of the industry. It is old stuff.”

“HST is a waste of money. There is not enough money in industry to build a HST.”

#### **ISSUES**

“NASA does not give things up, this is a big problem with the agency. They need to be able to evaluate our problems and determine if there is the right mixture of research..”

“NASA should avoid redundant efforts with the Air Force and Navy.”

“NASA should not be involved in land/ground issues - ATC, airports, etc. These areas should be left to DOT and FAA.”

“Make DOD pay the lion’s share for military technology development.”

## *Preliminary*

“NASA has too many centers. However, NASA can not lose facilities, wind tunnels and research labs.”

“Let the FAA do Air Traffic Control.”

“Every time NASA has tried to develop a new vehicle type they have gotten themselves in trouble, NASP for example, they should concentrate on technologies, not vehicles.”

### **GONE TOO FAR**

“NASA has been cut way too much and it is the poor step child to a lot of other government agencies.”

“Nothing. NASA has been working for years to develop better ways of doing research in the most effective manor.”

“Funding needs to be protected so that current programs do not take money from future products. For an example, if there is a problem with the existing fleet that must be addressed, money may be reallocated from the space station program.”

### **NOTES**

“Your questionnaire did not touch on training issues. Greater emphasis should be placed on the role NASA plays in training the next generation of engineers and scientists. We need to help create people who are discovery oriented. What we are creating in this country are point and click people.”

“Final comment: There is a lack of understanding of infrastructure and the role it plays on development of technology. NASA is not developing new test capabilities, we are dependent on current infrastructure. Other nations are developing new test beds and are rapidly catching up with us. To stay a world leader we need to invest in better infrastructure.”